Development of a Prototype for the Thermal Infrared Composite Imaging Spectrometer instrument (TIRCIS)

Completed Technology Project (2017 - 2020)

Project Introduction

OBJECTIVES: A major challenge for infrared remote sensing instruments of cold outer solar system targets is simultaneously detecting surface composition as well as surface temperatures. For cold targets <200K, the weak solar insolation results in thermal emission being in the far-IR. Given compositional signature are sensed in mid-IR, the science instrument needs a broad spectral grasp extending to the far-IR. The instrument development proposed here will determine surface composition and temperature of cold targets by using two focal planes to measure simultaneously both the mid- and far-IR. The objective of the proposal is to develop to TRL 3 a versatile infrared imaging spectrometer, spanning the spectral wavelength range 7 to 50 μm, with spectroscopic measurements in the 7-14 μm range and radiometric band measurements spanning 7-50 μm. This instrument is ideal for missions to airless bodies, including but not limited to Triton on a future Neptune Flagship-class mission, Trojan Asteroids, Enceladus or Io New Frontiers class missions. This instrument will build on substantial existing heritage and investments at GSFC, including the Voyager IRIS, Cassini CIRS, and recently a Thermal IMager for Europa Reconnaissance and Science (TIMERS) concept developed under Instrument Concepts for Europa Exploration (ICEE). The proposed instrument development will provide NASA a cold target optimized thermal imaging spectrometer to study cryovolcanism, heat flow, composition, and terrain. The innovative dual-focal plane design provides simultaneous mapping at mid and far IR wavelengths. The baseline design uses a custom 4-line 32 thermopile pixel array and a 384x288 pixel microbolometer array. The instrument has the capability to resolve temperature contrast to an accuracy of better than or equal to 2 K for surface temperatures greater than 70 K. The instrument can also provide 7-14 μm spectra of the surface with a spectral resolution of 200-350. METHODOLOGY: The thermal imaging spectrometer proposed here will build on substantial work that has already been done at GSFC on thermal instruments. In particular, this proposal will develop the key measurement concept namely the thermopile focal plane, which measures thermal radiation with multiple channels from 7-50 μm and allows some light to pass into a optical backend that measures the spectra from 7-14 μm. This backend consists of an Offner spectrometer that incorporates a grating and images a slit onto a microblomter array. Designed for pushbroom operation, the spacecraft velocity will be used to map the surface. The project has a work plan to develop the instrument over 3 years to TRL 3. We will begin with optical, mechanical and focal plane subsystem development, and finish with fabrication of key components to demonstrate key elements and provide a proof of concept of instrument capabilities. RELEVANCE: The proposed instrument development project responds directly to the PICASSO goal "to conduct planetary and astrobiology science instrument feasibility studies, concept formation, proof of concept instruments, and advanced component technology development." The specific missions that we are targeting are a Flagship-class mission – currently under study by the Ice Giants Science

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

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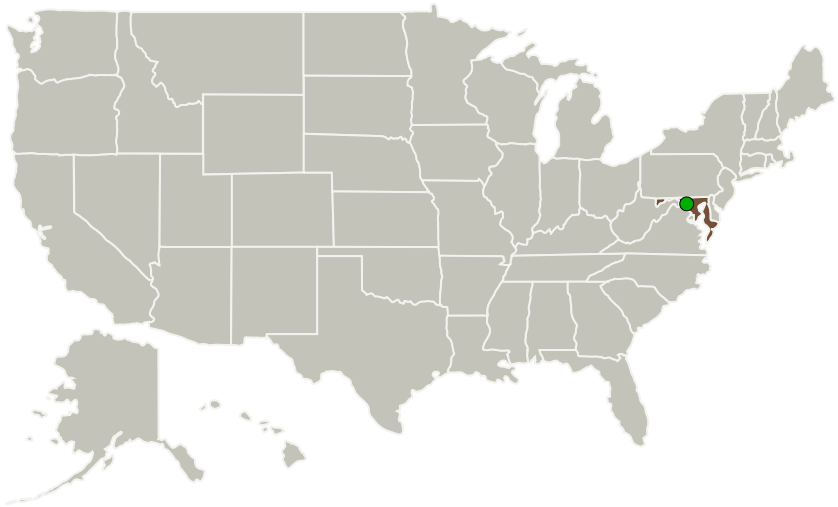
Definition Team – and also New Frontiers missions to Io, Enceladus and Trojan asteroids. We will achieve this goal through development of a proof of concept prototype. Through infrared thermal mapping of planetary surfaces, this instrument will directly address science questions raised in the 2013 Decadal Survey for Planetary Sciences.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

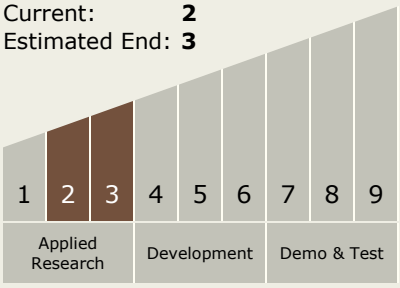
Terry A Hurford

Co-Investigators:

Tilak Hewagama
David T Leisawitz
Donald E Jennings
Shahid Aslam

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

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Target Destination

Others Inside the Solar System